

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant(s): Robert Cochran and Jeffrey D. Ferreira-Pro
Assignee: Hewlett-Packard Development Company L.P.
Title: HIERARCHICAL STORAGE SYSTEM
Serial No.: 10/697,821 Filing Date: October 29, 2003
Examiner: Vy, Hung T Group Art Unit: 2821
Docket No.: 200311026-1 Confirmation No.: 9535

Irvine, California
December 17, 2008

MAIL STOP AMENDMENT
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APPELLANT'S BRIEF

Dear Sir:

This paper is responsive to the Final Office Action dated July 14, 2008, having a shortened statutory period expiring October 14, 2008. Reconsideration is respectfully requested.

I. REAL PARTY IN INTEREST

The entire interest in the present application has been assigned to Hewlett-Packard Development Company, L.P., a Texas Corporation, as recorded at reel 014158, frame 0968. The place of business is currently 20555 SH 249, Houston, TX 77070.

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II. RELATED APPEALS AND INTERFERENCES

No other appeals or interferences are known to the appellant, the appellant's legal representative, or assignee which will directly affect or be directly affected by or have bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-25 are rejected

Claims 1-4 and 10-13, 18-22 and 24-25 are rejected under 35 U.S.C. §102(e) as being anticipated by Belsan et al. (US Patent No. 5,403,639).

Claims 5-9, 14-17 and 23 are rejected under 35 U.S.C. §103 (a) as being unpatentable over Belsan et al. (U.S. patent No. 5,403,639) in view of Lee et al. (US Patent No. 7,047,358).

The rejections of Claims 1-25 are on appeal.

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IV. STATUS OF AMENDMENTS

The appellants have made no additional amendments in response to the Final Office action dated July 24, 2008, so that all amendments are entered.

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V. SUMMARY OF CLAIMED SUBJECT MATTER

Independent Claim 1 and associated dependent Claims 2-9 are described in the original specification in paragraphs [0016] to [0027] and [0035], and Figures 1, 5A, and 5B, and pertains to a storage system (100) comprising a storage array (102) comprising a cabinet (502), a plurality of storage devices (104) contained within the cabinet of at least three different and distinct controller-to-storage device bus interface technology types including volatile solid-state (106) and non-volatile disk types (108, 110) in a single array and having a respective class hierarchy, and a controller (112). The controller (112) is contained within the cabinet (502) and coupled to the storage device plurality (104) and executes hierarchical storage management and selectively controls usage of storage according to the different and distinct controller-to-storage device bus interface technology type whereby the controller (112) allocates hierarchically inferior storage (110) for temporary storage, unexpected mission-critical storage, and hierarchical storage management (HSM)-type low usage data storage.

Independent Claim 10 and associated dependent Claims 11-17 are described in the original specification in paragraphs [0050] to [0055], and Figure 7, and pertains to a method of managing (700) information storage in a storage system comprising enclosing (702) an hierarchy of storage devices of at least three different and distinct controller-to-storage device bus interface technology types including volatile solid-state and non-volatile disk types in a cabinet forming a single array and having a respective class hierarchy within a storage array, and selectively controlling (704) information usage of storage according to the different and distinct controller-to-storage device bus interface technology type. The method further comprises using (708) hierarchically inferior storage for temporary storage, unexpected mission-critical storage, and hierarchical storage management (HSM)-type low usage data storage.

Independent Claim 18 and associated dependent Claims 19-23 are described in the original specification in paragraphs [0035] to [0038], and Figures 1, 5A and 5B, and pertains to a storage system (500) comprising a disk array (504). The disk array (504) comprises a cabinet (502), an hierarchy of disk adapters (120, 122) and coupled

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storage disks contained within the cabinet (502), and a controller (510). The hierarchy of disk adapters (120, 122) and storage disks (506, 508) includes at least two different and distinct controller-to-storage device bus interface technology types and have a respective class hierarchy. The controller (510) is coupled to the disk array (504) and contained within the cabinet (502), and executes an hierarchical storage management functionality that selectively controls access to the hierarchy of disk adapters and coupled storage disks (506, 508) whereby the controller allocates hierarchically inferior storage for temporary storage, unexpected mission-critical storage, and hierarchical storage management (HSM)-type low usage data storage.

Independent Claim 24 is described in the original specification in paragraphs [0048] to [0055], and Figure 7, and pertains to an article of manufacture comprising a tangible computer-readable medium having a program code for execution on a controller embodied therein for managing a storage system. The program code further comprises code that causes the controller to intercommunicate among an hierarchy of storage devices of at least three different and distinct controller-to-storage device bus interface technology types including volatile solid-state and non-volatile disk types in a cabinet forming a single array and having a respective class hierarchy within a storage array, code that causes the controller to selectively control information access to the hierarchy of storage devices within the storage array, and code that causes the controller to use hierarchically inferior storage for temporary storage, unexpected mission-critical storage, and hierarchical storage management (HSM)-type low usage data storage.

Independent Claim 25 is described in the original specification in paragraphs [0048] to [0055], and Figure 7, and pertains to a storage system comprising means for coupling an hierarchy of storage devices of at least three different and distinct controller-to-storage device bus interface technology types including volatile solid-state and non-volatile disk types in a cabinet forming a single array and having a respective class hierarchy within a storage array, means for selectively controlling information access to the hierarchy of storage devices within the storage array, and means for

using hierarchically inferior storage for temporary storage, unexpected mission-critical storage, and hierarchical storage management (HSM)-type low usage data storage.

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VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether Claims 1-4 and 10-13, 18-22 and 24-25 are unpatentable under 35 §102(e) as being anticipated by Belsan et al. (US Patent No. 5,403,639).
2. Whether Claims 5-9, 14-17 and 23 are unpatentable under 35 U.S.C. §103 (a) as being unpatentable over Belsan et al. (U.S. patent No. 5,403,639) in view of Lee et al. (US Patent No. 7,047,358).

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VII. GROUPING OF THE CLAIMS

Claims are grouped as follows:

1. Claims 1-4 and 10-13, 18-22 and 24-25 are rejected under 35 U.S.C. §102(e).
2. Claims 5-9, 14-17 and 23 are rejected under 35 U.S.C. §103 (a)

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VIII. ARGUMENT

(i) Grounds of Rejection under 35 U.S.C. §102

Claims 1-4 and 10-13, 18-22 and 24-25 are rejected under 35 U.S.C. §102(e) as being anticipated by Belsan et al. (US Patent No. 5,403,639). The claims distinguish over Belsan which does not disclose “a storage array comprising a cabinet [and] . . . storage devices contained within the cabinet of at least three different and distinct controller-to-storage device bus interface technology types.” Inclusion of the multiple types of storage in a single cabinet or device enables efficient and flexible data handling without extensive input/output traffic between systems housing the multiple device types. What Belsan discloses, as shown in Figures 1 and 2, are storage array units that individually contain only a single controller-to-storage device bus interface technology type in addition to a cache type, and not “at least three different and distinct controller-to-storage device bus interface technology types” as is claimed. Column 3, lines 30-35, of Belsan describes “media used to store the data can be a disk array or any other media or combination of media such as a disk array in combination with a backend automated magnetic tape cartridge library system including a plurality of tape drives such that the file server system comprises a hierarchical data storage system containing multiple types of media” which relates to combinations of media of different types in distinct arrays and devices, but does not describe a single, contained disk array that includes multiple bus interface technology types. Belsan column 4, for example at lines 34-38 and 60-64 similar describe combinations of media of different types in distinct arrays and devices, but not a single, contained disk array that includes multiple bus interface technology types. Belsan Figure 2 and described in column 8, lines 8-11, describe an import/export control unit 208 that is used for intercommunication with multiple types of media that are not contained within a single cabinet (a single file server system) but rather communicative connection of separate file server systems (1, 9, 10 of Belsan Figure 1). Belsan column 8, lines 15-20 show that the magnetic tape cartridges 10a and 10b are outside and separate from the data

storage subsystem 100 and individual disk arrays 103-1. The Belsan description of Figure 2 in column 8, lines 29-48, teaches disk drives 122-1 to 125-r as significantly less expensive than typical form factor disk drives. However, the “less expensive” drives 122-1 to 125-r are the only drives in the array 100 so that Belsan does not describe a single, contained disk array that includes multiple bus interface technology types.

The claimed combination of an hierarchy of storage types within an individual array enables allocation of storage for different purposes without the overhead of network communication in systems such as that shown in Belsan in which the different storage technologies are in separate arrays.

(i) Grounds of Rejection under 35 U.S.C. §103

Claims 5-9, 14-17 and 23 are rejected under 35 U.S.C. §103 (a) as being unpatentable over Belsan et al. (U.S. patent No. 5,403,639) in view of Lee et al. (US Patent No. 7,047,358). The claims distinguish over Belsan in view of Lee which do not disclose “a storage array comprising a cabinet [and] . . . storage devices contained within the cabinet of at least three different and distinct controller-to-storage device bus interface technology types.”

(iii) General Grounds of Rejection

The appellants do not appeal any additional general grounds of rejection.

I hereby certify that this correspondence is being electronically transmitted to the USPTO on the date shown below:

/Joy C. Ngo/
(Signature)

Joy C. Ngo
(Printed Name of Person Signing Certificate)

December 17, 2008
(Date)

Respectfully submitted,

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IX. CLAIMS APPENDIX

Claims remaining in the application are as follows:

1. (Previously presented): A storage system comprising:
a storage array comprising:

a cabinet;

a plurality of storage devices contained within the cabinet of at least three different and distinct controller-to-storage device bus interface technology types including volatile solid-state and non-volatile disk types in a single array and having a respective class hierarchy; and

a controller contained within the cabinet and coupled to the storage device plurality that executes hierarchical storage management and selectively controls usage of storage according to the different and distinct controller-to-storage device bus interface technology type whereby the controller allocates hierarchically inferior storage for temporary storage, unexpected mission-critical storage, and hierarchical storage management (HSM)-type low usage data storage.

2. (Previously presented): The storage device according to Claim 1 wherein:
the storage array contains an hierarchy of storage devices connected by at least three different and distinct controller-to-storage device bus interface technology types that have a respective performance hierarchy.

3. (Previously presented): The storage device according to Claim 1 further comprising:

the storage array contains an hierarchy of storage devices connected by at least three different and distinct controller-to-storage device bus interface technology types that have a respective economic or cost hierarchy.

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4. (Previously presented): The storage device according to Claim 1 further comprising:

a solid state cache and shared memory coupled interior to the controller and supplying storage as a distinct controller-to-storage device bus interface technology type for a level of hierarchical storage.

5. (Previously presented): The storage device according to Claim 1 further comprising:

Small Computer Systems Interface (SCSI) and/or Fibre Channel (FC) storage devices coupled to the controller by SCSI and/or FC buses and supplying storage as a distinct controller-to-storage device bus interface technology type for a level of hierarchical storage.

6. (Previously presented): The storage device according to Claim 1 further comprising:

Serial AT-attached (SATA) storage devices coupled to the controller by a SATA bus and supplying storage as a distinct controller-to-storage device bus interface technology type for a level of hierarchical storage.

7. (Previously presented): The storage device according to Claim 1 further comprising:

a solid state cache and shared memory coupled interior to the controller and supplying storage as a distinct controller-to-storage device bus interface technology type for a first level of hierarchical storage;

relatively higher performance Small Computer Systems Interface (SCSI) and/or Fibre Channel (FC) storage devices coupled to the controller by SCSI and/or FC buses and supplying storage as a distinct controller-to-storage device bus interface technology type for a second level of hierarchical storage;

relatively lower performance Serial AT-attached (SATA) storage devices coupled to the controller by a SATA bus and supplying storage as a distinct controller-to-storage device bus interface technology type for a third level of hierarchical storage; and

a process executable in the controller allocates storage capacity of the SATA storage devices to low access customer data and to short-term and unpredictable storage usage.

8. (Original): The storage device according to Claim 7 further comprising: an hierarchical storage management controller for usage within a disk array utilizing Fibre Channel (FC) and SATA disk drives and that allocates SATA storage as uncommitted and unstructured storage.

9. (Original): The storage device according to Claim 7 further comprising: an hierarchical storage management controller for usage within a disk array utilizing Fibre Channel (FC) and SATA disk drives and that allocates SATA storage for intra-array and/or inter-array data transfers including logical unit (LUN) copies and snapshots.

10. (Previously presented): A method of managing information storage in a storage system comprising:

enclosing an hierarchy of storage devices of at least three different and distinct controller-to-storage device bus interface technology types including volatile solid-state and non-volatile disk types in a cabinet forming a single array and having a respective class hierarchy within a storage array;

selectively controlling information usage of storage according to the different and distinct controller-to-storage device bus interface technology type; and using hierarchically inferior storage for temporary storage, unexpected mission-critical storage, and hierarchical storage management (HSM)-type low usage data storage.

11. (Previously presented): The method according to Claim 10 further comprising:
coupling an hierarchy of storage devices into the storage array including at least three different and distinct controller-to-storage device bus interface technology types that have a respective performance hierarchy.

12. (Previously presented): The method according to Claim 10 further comprising:
coupling an hierarchy of storage devices into the storage array including at least three different and distinct controller-to-storage device bus interface technology types that have a respective economic or cost hierarchy.

13. (Original): The method according to Claim 10 further comprising:
combining an hierarchy of storage devices into the storage array including at least a volatile shared memory, a relatively higher performance non-volatile storage, and a relatively lower performance non-volatile storage.

14. (Original): The method according to Claim 10 further comprising:
combining an hierarchy of storage devices into the storage array including at least a solid state cache and shared memory supplying storage for a first level of hierarchical storage, relatively higher performance Small Computer Systems Interface (SCSI) and/or Fibre Channel (FC) storage devices supplying storage for a second level of hierarchical storage, and relatively lower performance Serial AT-attached (SATA) storage devices supplying storage for a level of hierarchical storage.

15. (Original): The method according to Claim 14 further comprising:
allocating storage capacity of the SATA storage devices to low access customer data and to short-term and unpredictable storage usage.

16. (Original): The method according to Claim 14 further comprising:
allocating SATA storage as uncommitted and unstructured storage.

17. (Original): The method according to Claim 14 further comprising:
allocating SATA storage for intra-array and/or inter-array data transfers including
logical unit (LUN) copies and snapshots.

18. (Previously presented): A storage system comprising:
a disk array comprising:

a cabinet;

an hierarchy of disk adapters and coupled storage disks contained within
the cabinet, the hierarchy of disk adapters and storage disks of at
least two different and distinct controller-to-storage device bus
interface technology types and having a respective class hierarchy;
and

a controller coupled to the disk array and contained within the cabinet that
executes an hierarchical storage management functionality that
selectively controls access to the hierarchy of disk adapters and
coupled storage disks whereby the controller allocates
hierarchically inferior storage for temporary storage, unexpected
mission-critical storage, and hierarchical storage management
(HSM)-type low usage data storage.

19. (Previously presented): The storage system according to Claim 18
further comprising:

a cache memory coupled interior to the controller and operable as an additional
storage in the class hierarchy.

20. (Original): The storage system according to Claim 18 further
comprising:

an hierarchy of storage devices having a respective performance hierarchy.

21. (Original): The storage system according to Claim 18 further
comprising:

an hierarchy of storage devices having a respective economic or cost hierarchy.

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22. (Previously presented): The storage system according to Claim 18 further comprising:

the controller comprising at least two controller units; and
a mirror connection between the at least two controller units.

23. (Previously presented): The storage system according to Claim 18 further comprising:

relatively higher performance Small Computer Systems Interface (SCSI) and/or Fibre Channel (FC) disks coupled to the controller by SCSI and/or FC buses and supplying storage for a first level of hierarchical storage;
relatively lower performance Serial AT-attached (SATA) disks coupled to the controller by a SATA bus and supplying storage for a second level of hierarchical storage; and
a process executable in the controller allocates storage capacity of the SATA disks to low access customer data and to short-term and unpredictable storage usage.

24. (Previously presented): An article of manufacture comprising:
a tangible computer-readable medium having a program code for execution on a controller embodied therein for managing a storage system, the program code further comprising:

a code that causes the controller to intercommunicate among an hierarchy of storage devices of at least three different and distinct controller-to-storage device bus interface technology types including volatile solid-state and non-volatile disk types in a cabinet forming a single array and having a respective class hierarchy within a storage array;
a code that causes the controller to selectively control information access to the hierarchy of storage devices within the storage array; and
a code that causes the controller to use hierarchically inferior storage for temporary storage, unexpected mission-critical storage, and

hierarchical storage management (HSM)-type low usage data storage.

25. (Previously presented): A storage system comprising:
means for coupling an hierarchy of storage devices of at least three different and
distinct controller-to-storage device bus interface technology types
including volatile solid-state and non-volatile disk types in a cabinet
forming a single array and having a respective class hierarchy within a
storage array;
means for selectively controlling information access to the hierarchy of storage
devices within the storage array; and
means for using hierarchically inferior storage for temporary storage,
unexpected mission-critical storage, and hierarchical storage
management (HSM)-type low usage data storage.

X. EVIDENCE APPENDIX

None.

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XI. RELATED PROCEEDINGS

None.

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